

being less than two miles an hour, and calms constitute about one-third of the observations. Also it is shown, by the barometric registers of the Himalayan hill-stations, that that distribution of pressure which, on the plains, causes the north-east monsoon, does not exist and is even slightly reversed at an elevation of 7000 feet.

Hence, in Northern India, the state of things which produces the winter monsoon is restricted to a small height, and is then only an average and not a permanent condition; and that which chiefly characterises the atmosphere is its stillness, a condition in which any local action, small and feeble as it may be at first, may eventually set up a disturbance such as to revolutionise the existing conditions.

The cold weather rainfall is always the result of a local fall of the barometer, the formation of a barometric depression, which generally appears first in the Punjab or Western Rajputana, and then moves eastwards. Towards and around this depression the winds blow cyclonically (*i.e.* against the direction of the clock-hands), and the winds from the south, coming up charged with vapour which they have collected from the warmer land surface of the peninsula and sometimes from the sea, discharge this as rain chiefly to the east and north of the barometric minimum, where they form an ascending current.

Thus in the cold weather, rain generally begins in the Punjab and later on extends to the North-Western Provinces, Behar, and sometimes to Bengal. As the disturbance travels eastwards, it is followed up by a wave of high barometric pressure, and cool north-west winds, which usually last for a few days after the rain has cleared off.

The crucial point of the problem of the cold weather rains is, then, how to account for the formation of these occasional barometric depressions in a region where the barometer is generally high at this season. It has been suggested by one writer that they travel to us from the west across Afghanistan. This, however, can be only a guess in the dark, for, at the time it was made, there were no observatories to the west of India nearer than Bushire, at the top of the Persian Gulf. There is one now at Quetta, and I have examined the registers of this observatory to see if they give any support to the idea, and find that, with the exception of two doubtful instances, they do not. I conclude therefore that in most cases, if not in all, these disturbances originate in India, and their cause is to be sought for in the meteorological conditions of Northern India itself. In some instances they make their first appearance in Rajputana or Central India, and there can then be no question whatever of their purely local origin.

Now the region over which the winter rains are more or less regularly recurrent coincides with that in which the relative humidity of the air at this season, instead of diminishing towards the interior of the country, increases with the increasing distance from the coast. In any month between March and December, as we proceed from the coast of Bengal towards the Upper Provinces, the air becomes drier and drier, not only as containing an absolutely smaller quantity of water vapour, but also, in most months, in virtue of its increased capacity for taking up vapour, owing to its higher temperature. But from December to March the dryness increases inland only as far as Behar. Beyond this, although the quantity of vapour in the air remains very nearly the same or even undergoes a slight diminution, in virtue of the increasing cold there is an approach to that temperature at which this small quantity of vapour would begin to condense, forming cloud or fog; and it is in the Punjab that, in this sense, the air is most damp. The result is that which our registers show to be the case, *viz.* that from December to March it is also the most cloudy province. This seems to depend very much on the stillness of the air. The vapour that is always being given off from the earth's surface diffuses gradually upwards in the still atmosphere, and soon reaches such an elevation that it begins to condense as cloud. When once a moderately thick bank of cloud is thus formed, the equilibrium of the atmosphere is speedily disturbed. It is well known as a fact from Glaisher's balloon observations, and is also a consequence of the dynamic theory of heat, that the vertical decrease of temperature in a cloud-laden atmosphere is much slower (about one-third) than that in a clear atmosphere. This initial disturbance will suffice then to cause an indraught of air from around, an ascending current is set up, the barometer falls; warm, vapour-laden winds pour in from the south, and we have all the conditions of the winter rains.

If this view be just, the stillness of the atmosphere combined

with the presence of a moderate evaporation must be accepted as the condition which primarily determines the formation of barometric minima and the winter rains of Northern India. And this stillness is obviously due to the existence of the lofty mountain ranges which surround Northern India, leaving free access to the plains open only to the south.

Were the Himalayan chain absent and replaced by an unbroken plain stretching up to the Gobi Desert, it is probable that the winter rains of Northern India would cease; any local evaporation in the Punjab and Gangetic valley would be swept away by strong, dry, north-east winds blowing from the seat of high pressure, which, in the winter months, lies in Central Asia, and instead of the mild weather and gentle breezes which now prevail at that season on the Arabian Sea, it would be the theatre of a boisterous and even stormy monsoon, such as is its local equivalent of the China Seas.

SCIENTIFIC SERIALS

Bulletin de l'Académie des Sciences de St. Pétersbourg, vol. xxix. No. 2.—On a new comet, by O. Struve. Its elements, calculated by Herr Seyboth, are:— $T = 1884$, January 23^h 22^m 55^s average time of Pulkowa; $\pi = 92^{\circ} 19' 39''$; $\delta = 253^{\circ} 22' 52''$; $i = 74^{\circ} 21' 56''$; $\omega = 198^{\circ} 56' 47''$; $q = 9.87922$. Dr. Struve considers it as identical with the comet of 1812, calculated by Encke, and adds a note, by Herm. Struve, about the sudden increase of its light on September 19 to 22.—A report on M. Backlund's memoir on the motion of the comet of Encke from 1871 to 1881, by O. Struve.—On petrified wood from Ryazan, by Prof. Mercklin; it is like *Cupressinoxylon erraticum*.—Observations on some propositions relative to the numerical function $E(x)$, by V. Bouniakovsky (third paper).—Remarks on Ginkgo's "Kampakakathanakaka," translated by A. Weber, by Otto Böhtlingk.—On the contact of inverse figures with the polar reciprocals of the directing figures, by J. S. and M. N. Vanecek.—Note on wollastonite, by N. Kokscharow.—Telephonic phenomena in the heart produced by the irritation of *nervus vagus*, by N. Wedenski.—On the use of the telephone for the measurement of temperature, by R. Lenz.—On terrestrial currents compared with magnetic variations, by H. Wild.—On the variability of the light of γ Cygni, by Ed. Lindemann. The observations were made in 1881 to 1883, and the magnitude varied from 6.8 to 10.4, showing an annual periodicity. The star changed its colour, as also its shape, becoming sometimes more nebulous, and the changes could scarcely be explained by mere conditions of observations.—Determination of the parallax of α Tauri, by Otto Struve. Its value, deduced from observations made in 1850 to 1857, is $0''.516$, with a probable error of $0''.057$.—On some arithmetical consequences of the formulæ for the theory of elliptical functions, by Ch. Hermite.—Note on the discovery of kalait in Russia, by N. Kokscharow.—Studies on milk (second and third papers), by Heinrich Struve; being a series of analyses of cows' and human milk, which bring the author to the conclusion that there are two kinds of caseine, the α -caseine and the β -caseine.—On the atmospheric waves produced by the Krakatoa eruption, by M. Rykatcheff.

Verhandlungen des Naturhistorischen Vereins der preussischen Rheinlande und Westfalens, fortieth year, 1883.—Contributions to the knowledge of the igneous rocks in the Carboniferous hills and New Red Conglomerates between the Saar and the Rhine, by H. Laspeyres.—On the trachyte of Hohenburg near Bonn, by the same author.—A study of the Devonian formations between the Roer and Vicht Rivers, by E. Holzappel.—Remarks on the loess of the Lahn Valley, by F. F. von Dücker.—Tertiary shingles of marine origin on the slate hills of Nassau and Ems, by the same author.—An account of some living American reptiles, spiders, and insects found at Uerdingen amongst the dye-woods imported for the Crefeld silk dyeworks, by F. Stollwerck.—Report on the prehistoric remains of the Sieg Valley, by Dr. M. Schenck.—On the development of the mining and smelting industries in the Sieg district, by H. Gerlach.—Remarks on some monstrosities and aberrations in the colour of the mammals of Westphalia, by Dr. H. Landois.—On the greenstone of the Upper Ruhr Valley and its association with the slates of the Lenne district, by A. Schenck, jun.—A description of some archaeological remains from the Vlotho district, Weser Valley, by H. D'Oench.—A contribution to the study of the flora of the Rhenish Province, by M. Melzheimer.—A survey of the geological relations in the French Ardennes, by Prof. von

Lasaulx.—On the granites of the Watawa district, Bohemia, by Dr. J. Lehmann.—On the progress of electrical appliances, by H. Coeper.—Memoir on Anoplophora (*Unionia p. hlig*), by Prof. von Koenen.—Obituary notice of Dr. Hermann Müller of Lippstadt, by Ernst Krause.—On the crystals of oxalate of lime present in the foliage and stem of *Iris florentina* (four illustrations), by Prof. von Lasaulx.—Remarks on a human skull and other human remains recently discovered in the loess of the Mosel near Metternich, by Prof. Schaffhausen.—Report of a geological excursion to the island of Corsica, by Prof. von Rath.—On the bacillus of tuberculosis and its presence in the human tissues, by Dr. H. Menche.—Remarks on some small crystals of leucite of unusual formation, by Prof. von Rath.—On ten small mammoth teeth from the Schipka Cave, Moravia (one illustration), by Prof. Schaffhausen.—On the action of bromide of aluminium on the dibromide of acetyl and on benzene, by Dr. Anschütz.—On a new synthesis of anthracene, by the same author.—Note on pyrites from the Gommern and Ploetzky sandstone, near Magdeburg, by Prof. von Lasaulx.—On the treatment of bites by venomous snakes, by Prof. Binz.—On a manganese and copper alloy, by H. Heusler.—Report of a scientific excursion in the island of Sardinia, by Prof. von Rath.—On the Tertiary formations of the Bonn district, by Dr. Pöhlh.—On the naphtha and petroleum regions of Caucasia, by Dr. O. Schneider.—On the fossiliferous diluvium of the North German lowlands, by Dr. A. Remelé.—Microscopic examination of a series of Norwegian rocks from the Tromsø district and the Lofoten Islands, by A. Philippson.—Effects of heat on the optical bearing of crystals, by W. Klein.—On the properties of racemic acid and of the inactive pyrotartaric acid of calcium, by Dr. Anschütz.—Geological and palæontological researches in the Bonn district, by Dr. Pöhlh.—Microscopic examination of some specimens of volcanic matter from Krakatoa, by Prof. von Lasaulx.—Remarks on a new variety of glaukoppan from the island of Groix, on the west coast of Brittany, by the same author.

Rendiconti del R. Istituto Lombardo, May 29 and June 5.—Etruscan notes, by Prof. Elia Lattes.—Remarks on the laws affecting contract labour, by U. Gobbi.—On the colouring substances of putrefaction, and on some methods of discharging colours, by Dr. Paolo Pellacani.—On the supposed disposition to cretinism in patients operated on for affections of the parotid glands, by Dr. G. Fiorani.—A new determination of the latitude of the Brera Observatory, Milan, effected in the months of February and March of the present year, by L. Struve.—On a problem connected with the theory of stationary electric currents, by Prof. E. Beltrami.—On the nature of the colouring substance found in the urn of St. Ambrose, dating from the ninth century, by Prof. G. Carnellutti.—On the relation between the elasticity of some metallic wires and their electric conductivity, by Dr. G. Polini.

SOCIETIES AND ACADEMIES LONDON

Geological Society, June 25.—Prof. T. G. Bonney, D.Sc., F.R.S., President, in the chair.—James Campbell Christie was elected a Fellow, and Baron C. von Ettingshausen, of Graz, a Foreign Correspondent of the Society.—The following communications were read:—Additional notes on the Jurassic rocks which underlie London, by Prof. John W. Judd, F.R.S. Since the reading of the former paper on the subject (February 6, 1884) the well-boring at Richmond has been carried to a depth of more than 1360 feet. The point reached is, reckoning from Ordnance-datum line, 220 feet lower than that attained by any other boring in the London basin. A temporary cessation of the work has permitted Mr. Collett Homersham to make a more exact determination of the underground temperature at Richmond. At a depth of 1337 feet from the surface this was found to be $75\frac{1}{2}$ ° F., corresponding to a rise of temperature of 1° F. for every 52·43 feet of descent. The boring is still being carried on in the same red sandstones and "marls," exhibiting much false-bedding, which were described in the previous communication. The Rev. H. H. Winwood, of Bath, has had the good fortune to find the original fossils obtained by the late Mr. C. Moore from the oolitic limestone in the boring at Meux's Brewery in 1878. A careful study of these proves that, though less numerous and in a far less perfect state of preservation than the fossils from the Richmond well, they in many cases belong to the same species, and demonstrate the Great Oolite age of the strata in

which they occur.—On some fossil Calcsponges from the well-boring at Richmond, Surrey, by Dr. G. J. Hinde, F.G.S.—On the Foraminifera and Ostracoda from the deep boring at Richmond, by Prof. T. Rupert Jones, F.R.S.—Polyzoa (Bryozoa) found in the boring at Richmond, Surrey, referred to by Prof. J. W. Judd, F.R.S., by G. R. Vine, communicated by Prof. Judd, F.R.S.—On a new species of *Conoceras* from the Llanvirn beds, Aberciddy, Pembrokeshire, by T. Roberts, B.A. Only five species of *Conoceras* have as yet been described; the author compared the Llanvirn species with these, and also with a fossil from the Devonian of Nassau, which Kayser referred to *Gomphoceras*, but which possesses several characters in common with *Conoceras*. The horizon from which this new species was obtained is that of the Llanvirn beds, some typical Llanvirn fossils having been found with it. The author named the species *Conoceras llanvirnensis*.—Fossil Cyclostomatous Bryozoa from Australia, by A. W. Waters, F.G.S. In the present paper the Cyclostomata from Curdies Creek, Mount Gambier, Bairnsdale, Muddy Creek, &c., Aldinga and River Murray Cliffs were described, bringing the total number of fossil Bryozoa from Australia, dealt with in this series of papers, up to 195, of which 85 are known living. Of the 32 Cyclostomata now dealt with, 12 at least are known living, and one cannot be distinguished from a Palæozoic form; 9 are apparently identical with European Cretaceous fossils. Although so many remind us of European Chalk and Miocene species, great stress was laid upon the imperfect data available for such comparisons, the Cyclostomata furnishing but few characters which are available for classification, which, so far, has, almost entirely been based upon the mode of growth, which, in the Chilostomata, has been shown to be of secondary value. In consequence of the few available characters, the Cyclostomata do not seem likely to be ever as useful palæontologically as the Chilostomata, and as they are less highly differentiated, it is not surprising to find that they are more persistent through various periods. In order to see how far other characters might be available, the author has examined Cyclostomata, both recent and fossil, from many localities and strata, and pointed out that the size of the zoecia should always be noticed, as also the position of the closure of this tube. The arrangement of the interzoecial pores may frequently give great assistance, and these are considered the equivalents of the rosette-plates; but the most useful character of all is no doubt the ovicell, which varies specifically in position and structure; but this unfortunately occurs on but few specimens, and has rarely been described fossil, although greater attention to this will no doubt lead to its being frequently found and noticed.—Observations on certain Tertiary formations at the south base of the Alps, in North Italy, by Lieut.-Col. H. H. Godwin-Austen, F.R.S.—On the geological position of the Weka-Pass stone, by Capt. F. W. Hutton, F.G.S. The beds described in this paper are of older Tertiary and newer Secondary age, and occur in the northern part of Ashley county, in the province of Canterbury, between the Hurinui and Waipara Rivers. All of the beds are met with at Weka Pass, on the railway and road between Christchurch and Nelson, and the following is the section in descending order:—(1) Mount-Brown beds; pale yellowish sandstone with bands of shells and coral limestone, considered by all New Zealand geologists upper Eocene or Oligocene; (2) gray sandy marl; (3) Weka-Pass stone, yellowish with arenaceous limestone, usually with small green grains; (4) Amori limestone, white, flaggy, and argillaceous; (5) green sandstone with remains of marine Saurians. The last rests conformably on beds of coal and shale, with leaves of dicotyledonous Angiosperms, forming the base of the Waipara system. To this system Nos. 4 and 5 of the above section have also been referred by Dr. von Haast and the writer. The upper beds are the Oamara system of the same authors. The question to be decided is the limit between the two. The green sandstone (No. 5) and the coal shales are generally admitted to be Cretaceous. The geographical distribution of the beds enumerated was briefly described, the gray sandy marl (No. 1), the Amori limestone (No. 4), and the green sandstone having a northerly extension to Cook's Straits, whilst the other beds have been traced to the south only. An examination of the stratigraphical evidence shows that at Weka Pass, and also on the Waipara, the Weka-Pass stone rests on a water-worn surface of the Amori limestone, and near the Pass the former overlaps the latter. The gray marl (No. 2) is evidently unconformable to the lower beds of the Waipara system, whilst at Waipara and Weka Pass it passes down conformably into the Weka-Pass stone. The gray marl also passes up conformably